EXHIBIT 6

1005 Laser Facility Operations Overview

All aspects of OMEGA shot operations are under the direction and control of the OMEGA Facility Operations organization shown in Fig. I-4. OMEGA and OMEGA EP may be operated independently, with separate scientific objectives for each system, or jointly with the combined capabilities addressing a single requirement. For certain high-yield shots, the opposite facility will have to be in closed access even though the facilities are operating independently. The Shot Director(s) are under the overall direction of the Laser Facility Manager, who heads up the OMEGA Shot Operations watch organization. For joint OMEGA and OMEGA EP operations, the OMEGA EP Shot Director reports to the OMEGA Shot Director. This watch organization will directly control the actual shot operations and will be responsible for safety, shot execution, and data collection.

The CTHS filling, layering, and characterization systems are operated by qualified watchstanders under the direction and control of the Cryogenic and Tritium Facility Manager (see Fig I-5). The CTHS target chamber insertion and positioning systems are operated through the OMEGA facility watch organization (see Fig. I-4).

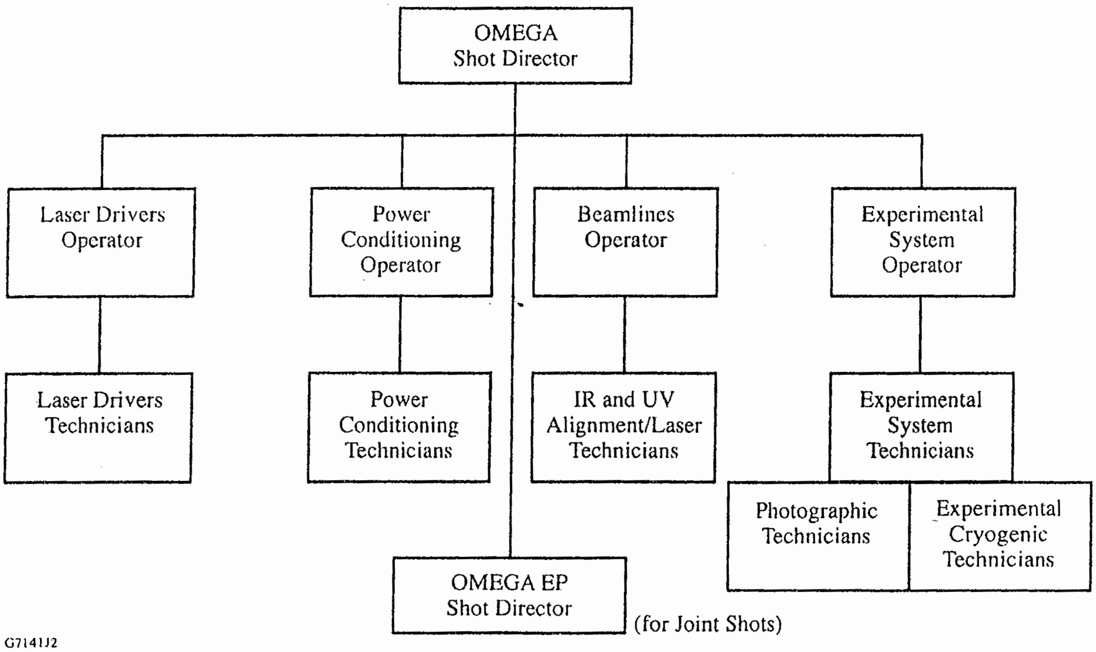

Figure I-4(a): OMEGA watch organization.

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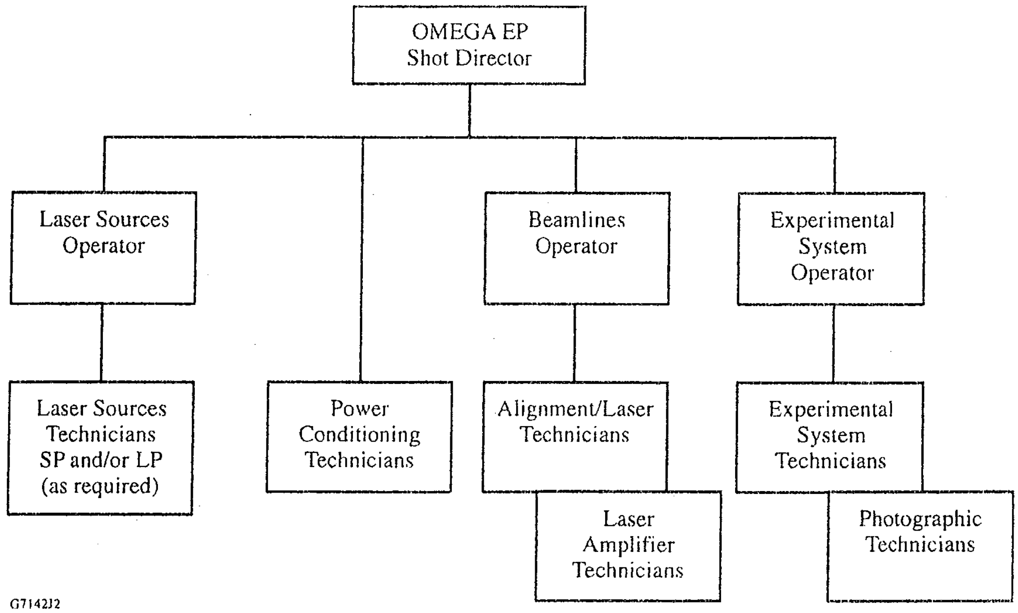


Figure I-4(b): OMEGA EP watch organization.

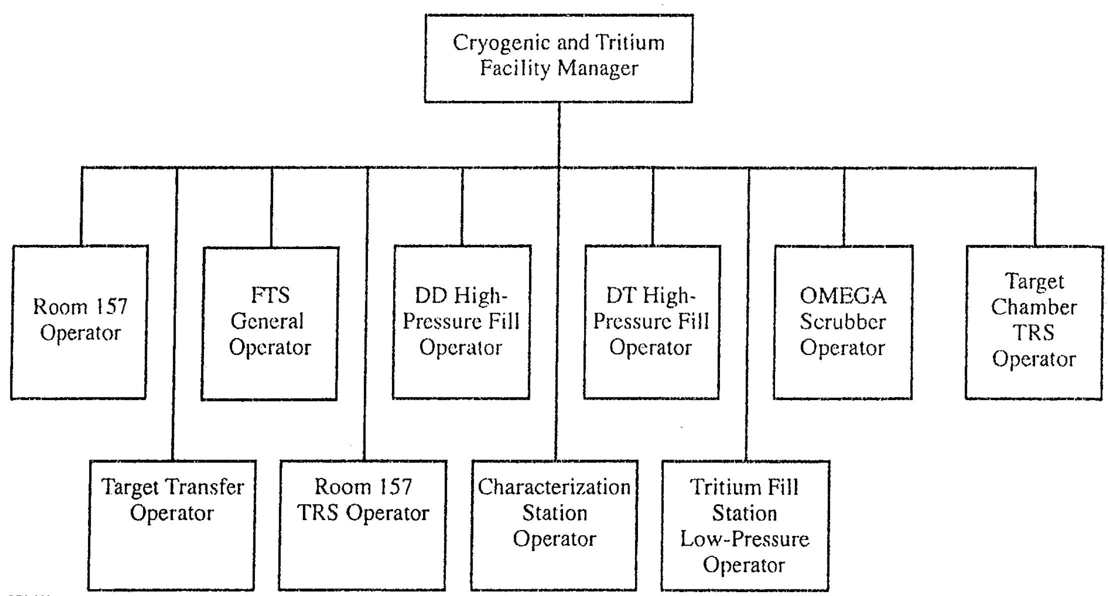


Figure I-5: CTHS organization.

The full OMEGA/OMEGA EP shot watch organization (excluding CTHS filling, layering, and characterization watches), unlike the divisional administrative organization, is operative only during shot operations. Personnel qualified for and assigned to these watches during specific periods of time may come from any of the Laboratory's divisions. While assigned to a watch, however, they report to and are directed by the Shot Director until relieved.

For shot operations, the watch organization shown in Fig. I-4 must be manned to the extent detailed in Sec. 2021. During non-shot periods (maintenance and/or scheduled system modifications or upgrades) only the Shot Director will be stationed.

System corrective and preventive maintenance will be scheduled and performed by the existing Laboratory administrative divisional organization. Divisional responsibilities for services (e.g., mechanical design, electronics design, computer software, etc.) and equipment/systems are detailed below. Where equipment and systems cross divisional lines, one lead Division is assigned the overall responsibility. Corrective and preventive maintenance will be scheduled in consonance with the Laser System Schedule approved by the FASC. Scheduled divisional maintenance will be approved by the Group Leader designated by the Division Director. The Laser Facility Manager, or Cryogenic and Tritium Facility Manager, as appropriate, or person appointed by them will review, track, and monitor the scheduling and completion of all key scheduled maintenance actions.

To ensure the operational readiness of the OMEGA/OMEGA EP Laser Facilities, including laser, target, cryogenic targets, and building support systems, the placing of major equipment or systems (those that would prevent completing a fully diagnosed target shot) out of commission will be controlled by the OMEGA Shot Operations watch organization under the direction of the Laser Facility Manager or the CTHS organization under the direction of the Cryogenic and Tritium Facility Manager as appropriate. The divisional representative will obtain permission from the on-watch Shot Director or Cryogenic and Tritium Facility Manager as appropriate prior to placing a major equipment or system out of commission. The return of equipment and systems to commission after maintenance will also be reported to the Shot Director or Cryogenic and Tritium Facility Manager as appropriate. The Shot Director and Cryogenic and Tritium Facility Manager will maintain a log for their areas of responsibility indicating the current status of equipment placed out of commission. Separate logs for the OMEGA compression facility, the OMEGA EP facility, and the CTHS facility will be maintained.

OMEGA Laser Facility service and equipment responsibilities are as follows:

<u>Facility and Engineering Divisions</u>

Services
- Clean room (Laser Bay and Target Bay)
- Electronics design
- Electronics shop
- Film Processing
- Machine shop

Mechanical design
Optical Fabrication shop
Optical Manufacturing shop

Equipment/Systems
Alignment sensor packages
Blast window assemblies, distributed phase plates, distributed polarization rotators
Deformable mirrors
De-ionized water and glycol cooling systems (including controls, indications, and purification)
Experimental control and data acquisition
Experimental target diagnostic peripherals (e.g., nose cones, filters, pin holes, etc.)
Focus lens subassembly
Frequency conversion
Grating compression chamber and beam transport tubes and associated vacuum systems
Grounding system
Hardware Timing System
Infrared alignment
Interlock system (door interlocks, motion detectors, warning light and alarm controls, and dump system)
Laser amplifiers
Laser amplifier structures (service cranes, etc.)
Laser beamline diagnostics (HED spectrograph, UV transport calibration, beam timing, pulse shape, and pulse contrast)
Laser control system (including interfaces, cabling, card cages, neuron modules, cable converters, and PLC subsystems *less* SUN workstations and displays, alignment video system)
Laser drivers—main, SSD, backlighter, and fiducial for OMEGA and short and long pulse for OMEGA EP (oscillators and pulse shaping)
Laser optomechanical elements (alignment sensors, polarization control optics, mirrors, beam splitters, flip-in devices, spatial filters, and path-length adjusters)
Nitrogen purge system
Off-axis parabola inserter–main plates
Optics
Parabola alignment diagnostic
Periscope mirror assembly
Plasma-electrode Pockels Cell (PEPC)
Power conditioning including PEPC power conditioning
Radiation detection system
Radio communication system
Short-pulse alignment
Spatial filters
Spatial-filter vacuum systems

Structures (end mirror, target mirror, target area, spatial filter, etc.)
Target chambers and associated vacuum systems
Target positioning
Target viewing
Ultraviolet alignment

Experimental Division

Services
Film digitizing
Target production

Equipment/Systems
Cryogenic Target Handling System
Experimental target diagnostics
Laser diagnostics (streak cameras and HED's)
Targets
Tritium removal systems

Theory Division

Services
Computing and networking
Software development and maintenance

Equipment/Systems
Alignment video system
Control system software
Imaging hardware
(Non-LON) network wiring and hub equipment
PC's
SUN workstations and displays

Administration Division

Services
Accounting
Administrative services
Facility improvements
Personnel services
Purchasing

Equipment/Systems
De-ionized water and glycol pumps, motors, and heat exchangers
Electrical distribution (switch gear, motor control centers, power panels, breakers, distribution to connected equipment, emergency diesel generators, and distribution to PCU's)
Heating, ventilation, air-conditioning system, and DDC system
Pneumatic air and nitrogen systems
Public address system

Target/Laser Bay 10-T cranes
Target Bay elevator

1006 Laser Facility Manager

The Laser Facility Manager is responsible for the overall operation and operational readiness of the OMEGA Laser System including the OMEGA compression and OMEGA EP facilities. The Laser Facility Manager reports to the OMEGA Facility Director. The LFM has a support staff of an Associate LFM and an Operations Analyst for OMEGA and OMEGA EP. The LFM has the following specific responsibilities: (Note: The LFM may delegate authority to the OMEGA or OMEGA EP Associate LFM to act for him as he deems appropriate.)

Manage the OMEGA Laser Facility to ensure that it is fully ready to execute the schedule of experiments proposed by the FASC and approved by the LLE Director.

Direct laser facility operations to ensure operations are conducted effectively and safely.

Directly supervise the OMEGA and OMEGA EP Shot Directors to ensure that he/she fulfills his/her responsibilities in operating the applicable facility.

Coordinate the preparation and submission of written procedures covering shot operations to the OMEGA Facility Director for approval. Approve written change notices as required to clarify or amend these procedures in advance of the approval of a formal revision by the OMEGA Facility Director.

Manage and control all laser facility maintenance to ensure operational readiness.

Make recommendations regarding the procurement of all laser facility services, operating equipment spares and supplies, and system upgrade components.

Be responsible for the overall system configuration control and management in close coordination with System Engineering.

Directly manage watchstander training and qualification and certify the qualification of the Shot Directors.

Serve as a member of the OMEGA FASC and provide this committee with a periodic report of system status and the status of completing scheduled experimental operations.

Approve the laser facility watchbills.

Maintain a list of laser facility qualified and proficient watchstanders.

Part II
Watch Organization and Watch Relief

2000 Watch Conditions

One of two watch conditions will be stationed whenever the OMEGA Laser Facility (LF) is open for scheduled maintenance or shot operations. These laser conditions apply independently to both OMEGA and OMEGA EP. Normally, the LF is open from 0400–1730 on Monday and Friday and from 0400–2030 on Tuesday, Wednesday, and Thursday. Extended shift experimental shot operations are conducted from 0800–2000 on

Tuesday, Wednesday, and Thursday maintenance is conducted on Monday, and maintenance, or laser-system shots, is conducted on Friday. The watch conditions are defined as follows:

Watch Condition 1: This watch condition applies during LF maintenance periods, the time prior to shot operations when preoperational checks are being completed, or when shot operations are disrupted for a significant period of time.

Watch Condition 2: This watch condition (Fig. II-1) applies during LF shot operations. It will be stationed when directed by the Shot Director prior to establishing "closed access" for the first shot of a day and remain stationed throughout the period of normal shot operations. This watch condition may be modified by securing watchstations not required for less than a full target shot type (Section 2021).

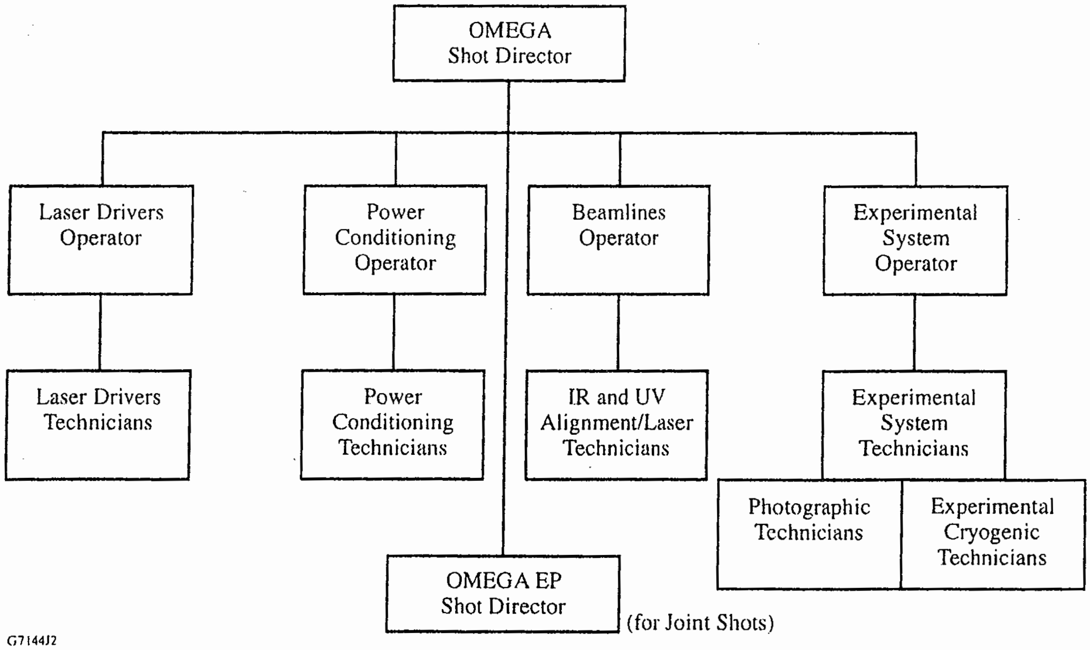


Figure II-1(a): OMEGA watch organization.

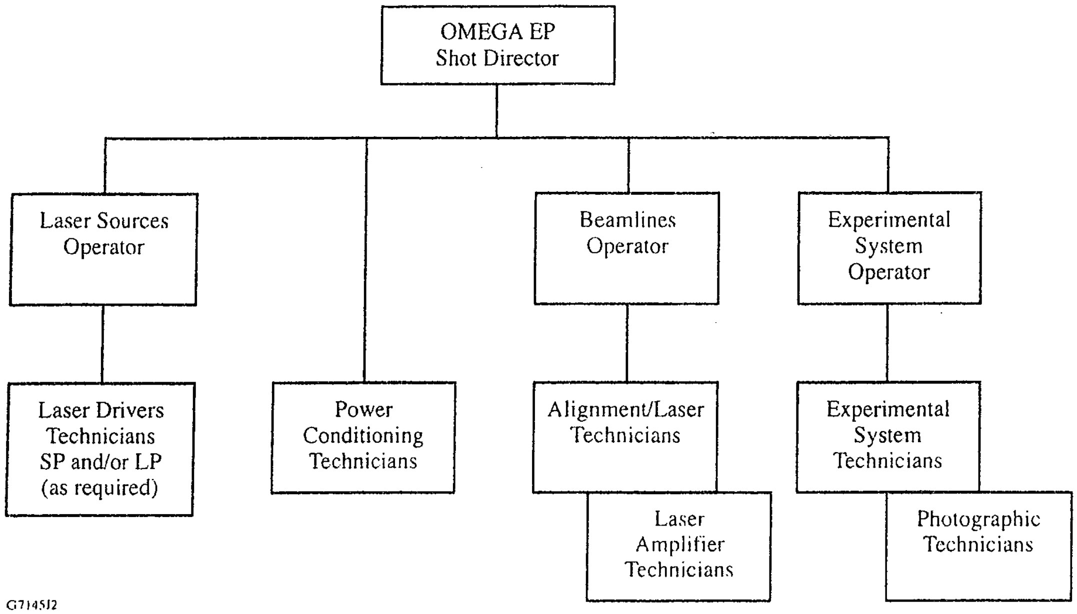


Figure II-1(b): OMEGA EP watch organization.

2001 Shot Director (SD)

The Shot Director (either for OMEGA or OMEGA EP) is the senior watchstander responsible for the overall operation of the respective laser facility during shot operations as well as during maintenance periods. The SD's area of responsibility includes the operational control of all laser and target systems, equipment, and ancillary support systems. Additionally, the SD operates the software applications that control facility access and safety interlocks, and the Shot Executive. A separate SD for OMEGA and OMEGA EP will be stationed whenever the applicable facility is open and will be located within the confines of the Laser Facility at all times when either Watch Condition 1 or 2 is stationed. With the approval of the Laser Facility Manager, a combined SD may be stationed when both OMEGA and OMEGA EP are in Watch Condition 1 as long as the SD is qualified on both systems. During stand-down periods, such as meal breaks, the Shot Director may go off-site briefly, as long as he/she has a digital pager. During the time from establishing "closed access" until a shot is completed, the SD must be present in the Control Room. The SD reports directly to the Laser Facility Manager. For joint operations, the OMEGA EP SD reports operationally to the OMEGA SD and administratively to the Laser Facility Manager. The SD's specific responsibilities include the following:

Direct operational control of the OMEGA or OMEGA EP laser system and assigned watchstanders in the completion of all laser and target shots. This includes

coordinating the completion of preoperational checks, alignments, and preparations required to fulfill the system or experimental requirements, directing the completion of actual system and experimental shots, and ensuring that the requisite system and experimental shot data are collected.

Operation of the Shot Executive.

Ensuring compliance with all procedural requirements of this LFORM, the Laser Facility Manual, Volume II or Volume VIII, Operating Procedures as applicable, and other LLE Instructions.

Ensuring compliance with safety procedures including that upon establishing "closed access" the applicable Laser Bay, Target Bay, Capacitor Bay, LaCave, Diagnostic Bays, Laser Sources Bay, and Viewing Gallery are cleared of all personnel, as appropriate, prior to executing a shot.

Ensuring that the Laser Facility shutdown checkoff contained in the System Operations Manual, Volume II or Volume IX, as applicable, is completed at the conclusion of operations. The shutdown checkoff should be completed daily at the end of maintenance or shot operations.

Control of system status including placing systems and equipment out-of-commission for maintenance and/or testing, maintaining the Equipment Status Log (Section 4004), and approving system/equipment Tagouts/Lockouts (Section 4005).

Reviewing the Equipment Status Log prior to assuming watch.

Controlling access to the Target Chamber Center to ensure against conflicting requirements.

Controlling access to the Control Room during Watch Condition 2 (Section 4001).

Ensuring that qualified and proficient watchstanders (Sections 2023 and 2027) are stationed in accordance with the posted watchbill (Section 2022) prior to conducting shot operations.

Keeping a Shot Director Log (Section 2026).

Conducting prewatch and watch-relief briefings as required.

Creating, controlling, and/or modifying shot templates, including updating the SRF database entries to reflect the final shot configuration.

Performing the functions of the Power Conditioning Operator (OMEGA EP SD only).

Keeping the Laser Facility Manager (LFM), Principal Investigator (PI), applicable Division Directors (Div. Dir.), and others, as appropriate, informed of system status and problems. As a minimum the following will be reported:

Failure to commence shot operations as scheduled (LFM, PI, Facility Director, and Exp. Div. Dir.).

Failure of a system, equipment, or diagnostic that disrupts operations (LFM, PI, applicable Div. Dir., and applicable Group Leader).

Opening and closing of a Target Chamber or the Grating Compression Chamber (LFM, Laboratory Safety Officer).

Accident or incident that causes personnel injury, causes or had the potential to cause significant equipment damage, or causes environmental discharge limits to be exceeded (LFM, applicable Div. Dir., Laboratory Safety Officer, applicable Functional Safety Officer). Additionally, incident investigation and reporting in accordance with LLEINST 6950 should be completed.

2002 Laser Drivers/Sources Operator (LDO/LSO) for OMEGA and OMEGA EP

The Laser Drivers/Sources Operator is the watchstander responsible for operation of the Laser Driver/Sources Executive to ensure that the necessary laser driver/source control, pulse shaping, and diagnostic functions are provided. He/she has overall responsibility for verifying that the laser driver/sources equipment is configured to support planned shot operations. The LDO/LSO will be stationed during Watch Condition 2 as required by Section 2021. During the time from establishing "closed access" until a shot is completed, he/she must be present in the Control Room. The LDO/LSO reports directly to the Shot Director. His/her specific responsibilities include the following:

Operation of the Laser Driver/Sources Executive and Pulse Shaping controls.

Keeping the Shot Director informed as to laser driver/sources status and reporting any system abnormalities or failures that affect the ability of the system to shoot.

Coordinating the efforts of the assigned Laser Drivers/Sources Technician Watchstanders in the operation of the Laser Driver/Sources System.

Reporting his/her relief to the Shot Director.

2003 Power Conditioning Operator (PCO)

The Power Conditioning Operator is the watchstander responsible for operation of the Power Conditioning Executive to ensure that the correct amplifiers are armed and that the charge voltages are consistent with operational limits and beam-balance requirements. He/she has overall responsibility for ensuring that the power conditioning equipment is configured to support planned shot operations. The PCO will be stationed during Watch

EXHIBIT 7

LLEINST 7700A
8 February 2002

LLE INSTRUCTION 7700A

SUBJECT: **DESIGN AND INTEGRATION OF EQUIPMENT**

ENCLOSURES: (1) Design Reviews
(2) Critical Equipment Qualification Checklist (CEQC)
(3) Critical Equipment Qualification Checklist Instructions

1. Purpose: To set up administrative procedures for coordinating the design and introduction of new or changed equipment/systems in the Laboratory. This instruction establishes the design review and documentation requirements to assure that all relevant factors are addressed during the design and qualification process.

2. Discussion: This policy applies to new or substantially revised equipment items including beam-generation and control equipment, target handling and positioning equipment, laser diagnostics, target diagnostics, and communication infrastructure. Generally, these will be projects with a task identification acronym, budget, Principal Investigator (PI), and Project Coordinator (PC). The resulting equipment will generally become a permanent part of OMEGA or other laboratories in the LLE/COI facility.

This policy is meant to add value to the process and not be bureaucratic. To this end, the process will be tailored to accommodate the characteristics of individual projects, particularly equipment items that are temporary or developmental.

Projects originated and developed externally that will be implemented at LLE must also comply with this policy, with a Project Coordinator assigned to oversee the development effort and facilitate communication with LLE. The details of the process will be tailored based on the characteristics of the item under development.

3. Procedures:

a. Projects will be subjected to at least two reviews: a Conceptual Design Review (CDR) that must be conducted prior to the release of allocated funds or the use of other LLE resources, and a Final Design Review (FDR) that is conducted prior to major fabrication or installation efforts. Additional reviews such as a Preliminary Design Review (PDR) will be conducted as appropriate. The PDR is particularly important for larger projects. The reviews that may be applicable are listed in sequence in enclosure (1). The “Standard Reviews” are recommended for a typical project. The “Optional Reviews” may be inserted

when warranted by the complexity or criticality of the project. The reviews mandated for "critical equipment" are also indicated.

b. Reviews will be publicized to all LLE employees and scheduled at least one week after the initial announcement. These meetings shall be coordinated through, and administered by, the System Engineering office. Reviews shall be documented with published minutes. "Action Items" will be documented, where appropriate to follow up on open issues.

c. Control, data handling, and operational integration issues will be addressed concurrently with the other project elements. Projects that include introduction of computers into OMEGA shall have the computers initiated, installed, and maintained in compliance with LLEINST 9800.

d. Projects shall include the preparation and validation of applicable test plans and operating procedures.

e. Equipment determined by the Engineering or Experimental Division Directors to be critical to laboratory science operations, such as new target diagnostics or laser front-end elements, will be tracked by the Critical Equipment Qualification Checklist (CEQC) process. The checklist and the instructions for its completion are attached as enclosures (2) and (3), respectively. This checklist will be tailored to each equipment project. As a result, all of the checklist items may not be applied to every project.

f. All projects shall be initially proposed to the responsible Division Director. In addition to need and budget rationale, the minimum information required for this step shall include a brief general description that allows classification as to type of equipment and permanency of the installation. Once a project has been approved for funding it will be administered in accordance with this Instruction.

4. Responsibilities:

a. <u>Principal Investigator (PI)</u>

(1) Develop projects, including justification in terms of how their completion will contribute to the Laboratory's research program.
(2) Ensure that Project budgets and schedules are prepared and kept current.
(3) Schedule, prepare, and present design reviews.
(4) Publish minutes from design reviews and ensure that all action items are completed.
(5) Prepare and complete test plans.
(6) Provide draft operating procedures to the System Engineering Group.
(7) Ensure that projects are completed on time and on budget.

b. <u>Project Coordinator (PC)</u>

(1) Under the direction of the PI, administer and coordinate the project.

c. **<u>Engineering Division Director</u>**

(1) Provide overall direction to the design, construction, and integration of Laboratory projects.
(2) Determine whether a project should be administered using a Critical Equipment Qualification Checklist.
(3) Certify of the completion of projects.

d. **<u>Experimental Division Director</u>**

(1) Determine whether a project should be administered using a Critical Equipment Qualification Checklist.
(2) Certify the completion of projects as appropriate.

e. **<u>System Engineering</u>**

(1) Administer the Laboratory's project design and integration program in accordance with this instruction.
(2) Support the PI/PC in fulfilling their responsibilities. This includes consultation in tailoring the requirements of this Instruction to the characteristics of the particular project, guidance in preparing for reviews, scheduling and publicizing reviews, and assisting in the generation and distribution of meeting minutes.
(3) Ensure that the CDR process results in a clear and timely decision on release of funds.
(4) Track the status of planned meetings and minutes.
(5) Where appropriate, participate in the development, validation, and formalization of test plans and operating procedures.

f. **<u>Experimental Operations Group Leader</u>**

(1) Administer the target diagnostic projects covered by the Critical Equipment Qualification Checklist (CEQC) process. This specifically includes tailoring of the checklist to the project.

g. **<u>Laser Driver Development Section Leader</u>**

(1) Administer the laser driver projects covered by the Critical Equipment Qualification Checklist (CEQC) process. This specifically includes tailoring of the checklist to the project.

h. **<u>Other LLE functional groups</u>**

(1) Support the PI/PC in accordance with normal laboratory practices.

6. Approval

Robert L McCrory
Director

Design Reviews

Standard Reviews	Optional Reviews	CEQC Req'mt
Conceptual Design Review (CDR) • Definition and functional requirements • Technical feasibility • Programmatic relevance • Straw-man schedule • Development responsibilities • Approval to expend funds		✓
	Project Requirements Review (PRR) • Develop consensus on technical performance requirements, criteria, or goals	
Preliminary Design Review (PDR) • Ready to proceed to detailed design • Complete, agreed requirements • Risks and alternatives considered • Integration issues (control, data, tests, procedures, training) identified • Refined schedule		
	Software/Control Requirements Review (CRR) • Details of hardware and software requirements • Operator interface features • Data handling and reduction	
Final Design Review (FDR) • Ready for fabrication of an operable unit • Detailed design meets the requirements • Performance demonstration tests & integration steps defined • Finalized schedule		✓
	Installation/Operational Readiness Review (ORR) • Status of demonstrations and preparations • Commit to operational use	

Critical Equipment Qualification Checklist

Designation: ____________________ **Project ID:** __________

PI, PC, or POC: ____________________ ____________________

____________________ **OSE Ref:** __________

External Org.: ____________________ **Req'd By:** __________

(Item amplifications follow.)

Item	**Scheduled Completion**	**Actual Completion**
Conceptual Design Review (CDR) — required item		
LLE funds released		
CDR minutes published		
Project Plan reviewed & published		
Physical envelope/space claim reviewed and cleared		
CEQC tailored and published		
CDR Action Items resolved		
Project Requirements Review (PRR)		
PRR minutes published		
Equipment requirements published		
Preliminary Design Review (PDR)		
PDR minutes published		
Project Plan updated and published		
Control, data handling, and integration tasks defined		
PDR Action Items resolved		
Laboratory development complete		
Performance demonstration complete		
Software/Control Requirements Review (CRR)		
CRR minutes published		
CRR Action Items resolved		
SRF updated for new experimental diagnostics		
Final Design Review (FDR) — required item		
LLEINST 9800 Computer Identification Data Sheet initiated		
FDR minutes published		
Fabrication approved		
Project Plan updated and published		
Fit and Qualification Test plans published		
Draft Installation and Operating Procedures published		
FDR Action Items resolved		

(CEQC continuation)

Designation: ____________________________ **Project ID:** ___________

Installation/Operational Readiness Review (ORR)		
ORR minutes published		
Installation approved		
ORR Action Items resolved		
Crew orientation conducted		
Hardware at LLE/Installed		
LLEINST 9800 Computer Identification Data Sheet completed		
Fit and Function Tests complete		
Qualification Tests complete		
Definitive Installation and Operating Procedures published		
Initial operator training conducted		
Final review — operation approved		

<u>Approved for Operation:</u>

PI	Experimental Operations (for Target Diagnostic Projects)	Director, Experimental Division
	Laser Driver Development Section Leader (for Laser Driver Projects)	LLE Mechanical Engineering
OMEGA System Engineer	Laser Facility Manager (for OMEGA Projects)	Director, Engineering Division

Critical Equipment Qualification Checklist Instructions

Designation:	Descriptive name unique in LLE / OMEGA context.
Project ID:	Identifying acronym assigned by LLE.
PI, PC, or POC:	Person who represents the equipment for or at LLE.
OSE Ref:	Designator assigned by OMEGA System Engineering for tracking purposes. Encodes internal/external, equipment type, funding status, and criticality (see details elsewhere).
External Org.	Non-LLE supplier, sponsor, or customer.
Req'd By	Date item is to be operational.
Item	Checklist items may be tailored to the project by marking "waived" or "NA" in the Scheduled Completion column. Items are waived or applied line-by-line regardless of the design review groupings.
Scheduled Completion	To be filled in for all items applicable to the project. Final date should be at least two weeks before the equipment is required to be operational.
Project Plan	An assembly of the programmatic documents required for critical equipment projects. Includes responsibilities, schedule with review, test/demonstration, and documentation milestones and applicable/waived markup of this CEQC.
Physical envelope … cleared	A check to assure that the equipment will fit and operate in intended location(s). For a Target Diagnostic, the CAD model of the TC is of primary importance.
Equipment requirements …	A concise statement of performance, physical and interface characteristics, documented and agreed.
PDR/Control ...	Where applicable, the control approach (expert in attendance, operator mediated, fully automatic …) and data-handling aspects define the mechanical, electronic, and software tasks to be managed as the project proceeds.
Fit and Function Tests	Trial installation (and operation, if practical) of actual or representative equipment.
Qualification Tests	Test operations that provide a definitive demonstration that the critical operating requirements are met.
Final Review	Informal meeting to assess status and sign CEQC.

EXHIBIT 8

THE UNIVERSITY OF ROCHESTER

INTRAMURAL CORRESPONDENCE
Laboratory for Laser Energetics

DESIGN REVIEW MEMORANDUM **June 7, 2005**

TO: **All Attendees**

COPIES: **R. Bahr, T. Duffy, T. Hinterman, M. Romanofsky, C. Sorce**

FROM: **V. Glebov**

SUBJECT: **PRR – High Yield Neutron Temporal Diagnostic (HYNTD) -- 6/7/02**

Reference: Design review material at:
hopi/Experimental/Diagnostic Development/HYNTD/...

Attendees:

J. Armstrong	**L. Lund**	**G. Pien**	**K. Thorp**
A. Dillenbeck	**D. Meyerhofer**	**T. C. Sangster**	**T. Wilson**
S. Loucks	**W. Owens**	**C. Stoeckl**	**M. Moran (LLNL)**

A Project Requirements Review for the OMEGA High Yield Neutron Temporal Diagnostic (HYNTD) was held on June 7, 2005. The review was presented by V. Glebov with action items described below.

Glebov described the need for a high yield version of the NTD to provide non-saturated data from shots with neutron yields in the 1e13 to 1e15 range. One of the possible solutions is to use a Light Pipe. The reentrant tube is to be inserted into the target chamber to a location 16 cm from TCC. The Light Pipe test design consists of three segments of 1" diameter pipe and two mirrors running to a streak camera currently located in LaCave. The first segment is inside the reentrant tube, which runs through port P11d to the first mirror. The light is sent down the light pipe to another mirror in LaCave, which reflects the light into the streak camera. The diagnostic will accept light from one of three sources; a scintillator, Neutron Cherenkov (SF6 glass) or a Threshold Cherenkov CO2 pressure cell.

Testing of this Light Pipe design was conducted in May and was qualified for testing on May 9, 2005. The Light Pipe diagnostic is currently dismantled, but will be reinstalled during the quarterly maintenance week, starting June 27th, for testing during high yield shots on July 11th. The purpose of this testing is to determine the time resolution, estimated to be 20 ps, and to measure the bandwidth of the Light Pipe. The Light Pipe timing calibration will be done by Glebov and C. Stoeckl during the week of July 25th.

After some discussion, it was determined that the Light Pipe design will be dismantled and its qualification will expire after completion of testing in July. A new design for HYNTD will be properly engineered to determines a permanent solution. This will include the full design review process It is expected that this process will take between four to six months to complete.

S. Loucks requires that the reentrant tube envelope is fully qualified and that the test design will not interfere in any way with the lower pylon for Cryo shots.

Initial requirements for HYNTD were determined to be 20 ps resolution, a minimum yield of 1e13, and a maximum yield of 1e15.

It was agreed that a project (HYNTD) will be initiated immediately and that a formal CDR is to follow the testing. Assigned to **V. Glebov**.

A. Dillenbeck, **G. Pien** and **V. Glebov** are tasked with determining the initial real estate issues such as port availability, conduit routes, shielding, and potential streak camera location. They are to explore routing through existing holes in the Target Bay floor to LaCave, and the possibility that a new hole may need to be drilled.

The Knock-On 2 diagnostic will need to be tagged-out while the HYNTD reentrant tube is installed (roughly from June 27 – July 22). **G. Pien** will check that KO2 is not required during that time.

M. Moran (LLNL) will be in charge of the Light Pipe testing during the week of July 11th.

V. Glebov will be conducting the timing calibration of the Light Pipe during the week of July 25th.

Completion of this project is expected in Fall 2005.

EXHIBIT 9

Enclosure (4)

FY 06 Project Budget Request
for
NEW Project

Proposed Task ID:	HYNTD
Project Title:	Nigh Yield NTD
Principal Investigator:	Vladimir Glebov
Proposed Project Coordinator:	Sam Roberts

Describe this project and why it is required to meet FY06 program objectives:

The existing OMEGA Neutron Temporal Diagnostic (NTD) is saturated by neutron-induced background at neutron yields higher than $3 \times 10^{13} - 5 \times 10^{13}$. Experiments with cryogenic DT target may exceed this yield limit. Fast Ignition experiments using both OMEGA and OMEGA-EP lasers can produce neutron yield up to 1×10^{15}. Therefore a new High Yield Neutron Temporal Diagnostic (HYNTD) is required for the future experiments on OMEGA. Recent tests on OMEGA demonstrated feasibility of a new NTD detector based on a light pipe. In this approach light from a scintillator in reentrant tube delivered to streak camera outside of the Target Bay area by a polished stainless pipe. The goal of this project is to build HYNTD based on light pipe.

In order to overlap in yield with the existing NTD the new HYNTD should have minimum sensitivity of 1×10^{13}. For the fast ignition experiments temporal resolution of the HYNTD itself should be 20 ps. Large distance from the target to streak camera and additional shielding should make HYNTD operational up to 1×10^{15}. Depending of a sub-port selection for the HYNTD a new hole in the Target Bay floor may be required. We plan to use ROSS streak camera for the HYNTD.

When HYNTD is not in use for LLE shots, it can be used for diagnostic development purposes as Gas Cherenkov Detector, Fast Neutron Detector (with lead glass instead of scintillator), nTOF detector, or Hard X-ray Temporal Diagnostic for indirect drive shots.

Resource Requirements (in hours) (other than PI and PC – NOTE: After budget approval, the PI must submit a work request to the appropriate group to start work)

ME 120 EE 0 OMAN 0 SDG 0 OPT. Eng. 40

Desired Completion Date and Justification:

January 2006
HYNTD should be ready for high yield DT cryogenic shots

CDR date 09/05 PDR date 10/05 FDR date 12/05

(Note: upon initial submission these will be "TBD", after the resource leaders have estimated the required effort, the PI will establish dates for the CDR, PDR, and FDR and notify System Engineering, the Engineering Director, and the Experimental Division Director (as appropriate).

Budget Justification/List materials required (this will suffice for the fabricated equipment justification if the project is approved)

Nomenclature	#	Unit Cost	Total Cost
Polished stainless pipes, swageloks	4	$500	$2,000
Fast scintillators	2	$500	$1,000
UV mirrors, filters	2	$500	$1,000
UV lenses	4	$500	$2,000
Tungsten cap, mechanical parts	1	$2,000	$2,000
Neutron shielding for streak camera	1	$2,000	$2,000
		Total Budget Estimate =	10,000

EXHIBIT 10

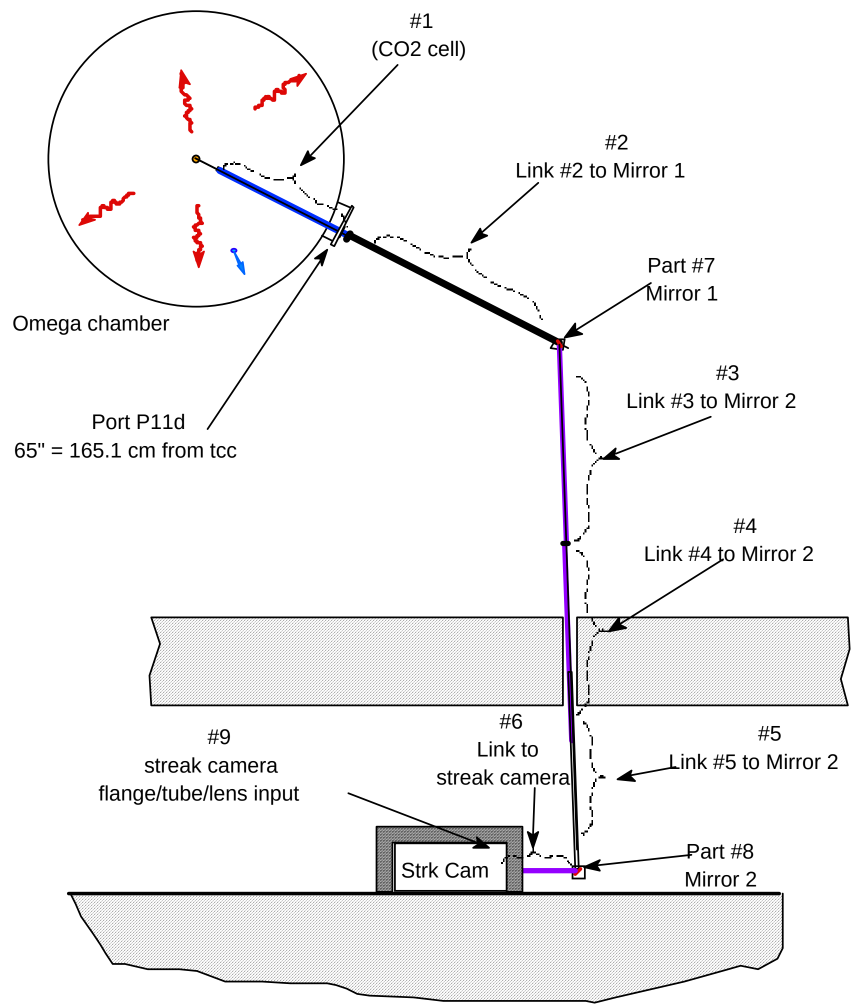
Conceptual Design Review 10/14/2005

Vladimir Glebov

High Yield Neutron Temporal Diagnostic (HYNTD) for OMEGA

OMEGA Light Pipe

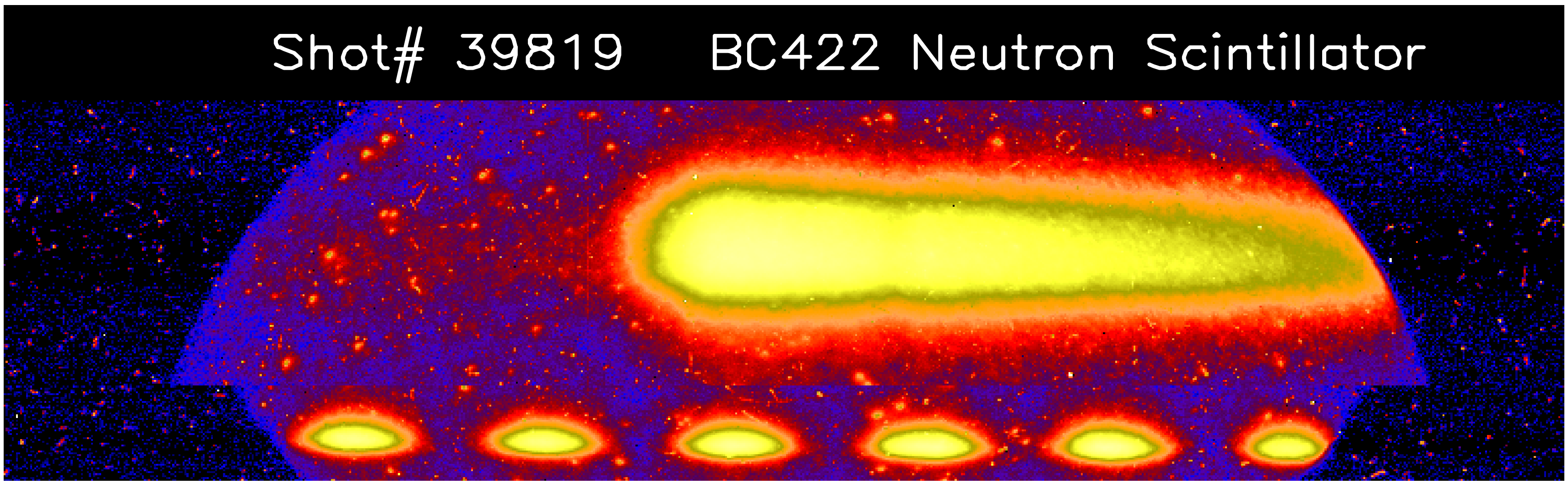
- Light pipe: target chamber to La Cave
  - 16 cm from TCC
  - Straight links, 2 mirrors
  - Laser pointer for alignment
  - To MCP or streak camera
- Three sources of signal:
  - Scintillator
  - Neutron Cherenkov (SF6 glass)
  - Threshold Cherenkov (CO_2)



Proof of principal of HYNTD was demonstrated in May 2005 during Light Pipe diagnostic test.

UR LLE

Shot # 39819, Yn = 3 x 10^{13}, 5 mm BC-422, 48 cm from TCC, ND=1



At 22 cm from TCC, 1 mm BC-422 HYNTD will be sensitive from 5 x 10^{12}
Upper limit: without shielding ~ 10^{14} , with proper shielding ~ 10^{15}

Time resolution: Light Pipe estimation 20 ps, not yet demonstrated.

We have learned some valuable lessons for the future HYNTD design from Light Pipe operations.

UR LLE

- **2" reentrant tube can interfere with beams offset from TCC.**

  Solution: two step reentrant tube with ~ 1" front end

- **100 ps x ray signal is not strong enough for timing calibration**

  Solution: make front end of the reentrant tube from Al

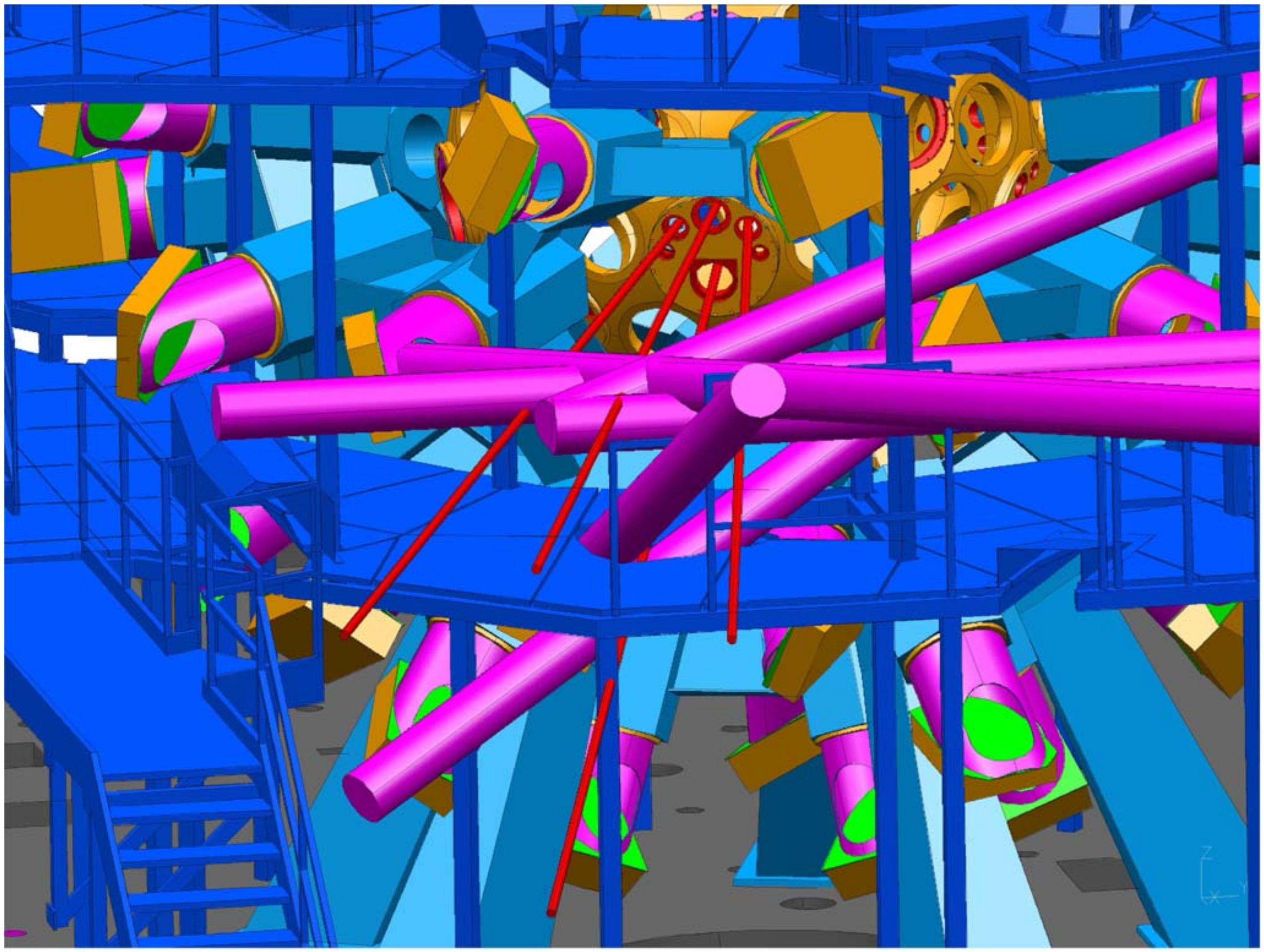
- **1" light pipe and support was not rigid enough**

  Solution: switch to 2" light pipe, make more rigid support.

  2" pipe => less number of reflections, more space for optics

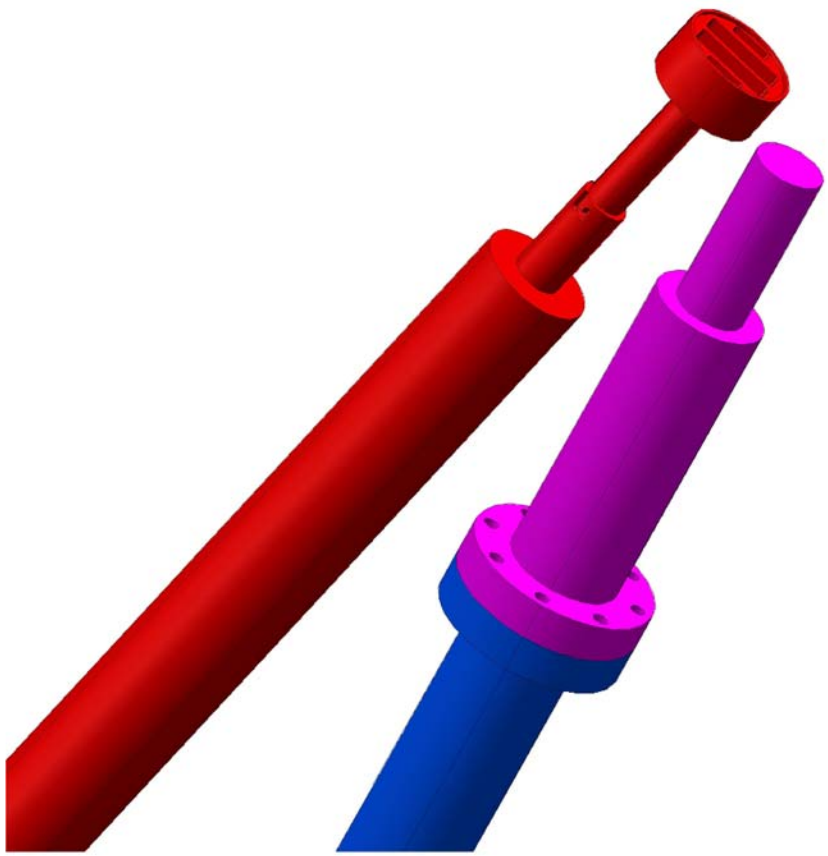
All 4”,6” and 8” sub-ports were analyzed as candidates for HYNTD, but only P11 looks like a reasonable candidate.

Sub-port H13



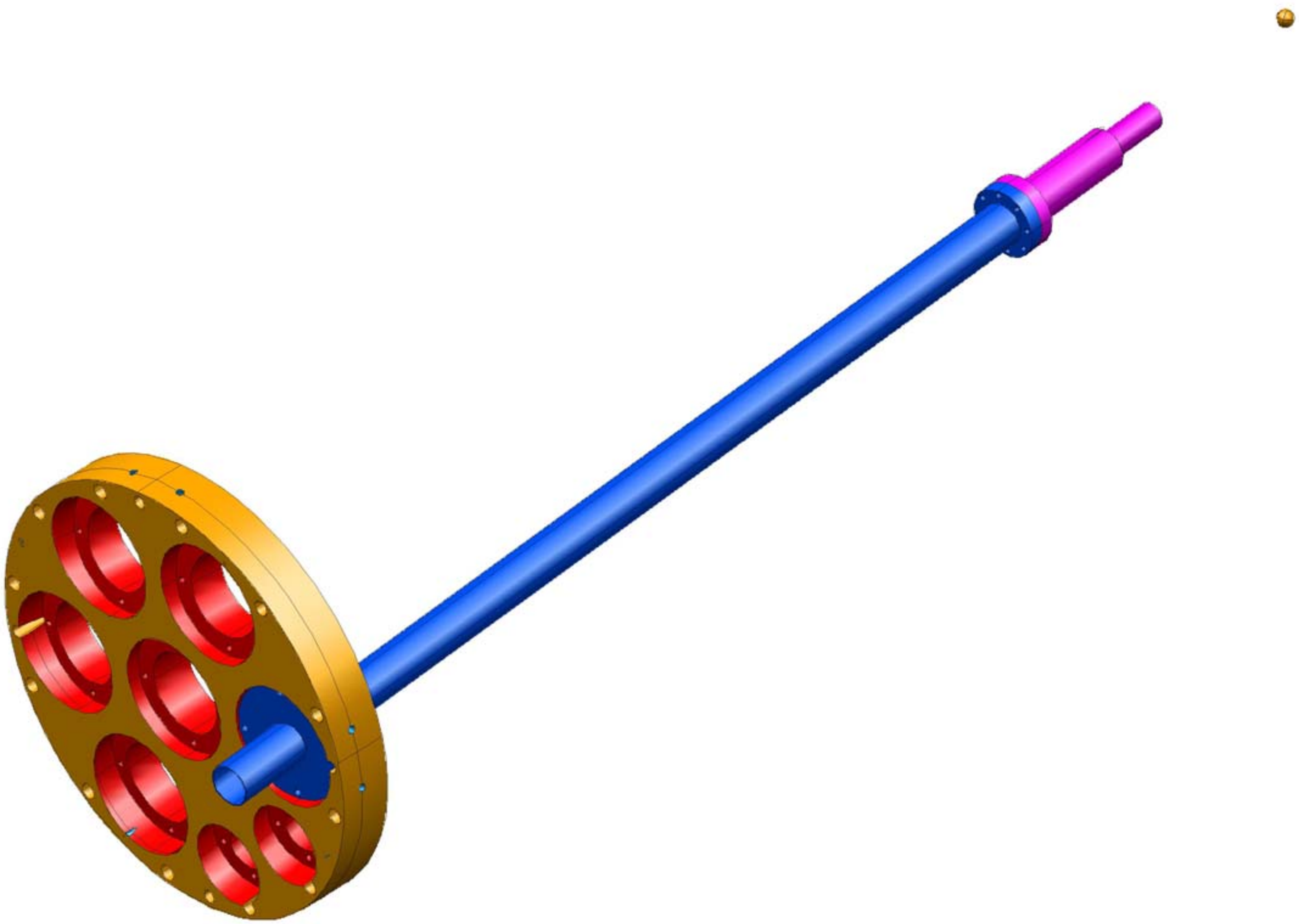
HYNTD in P11A will accommodate KO in P11D and PCD in P11H sub-ports.

UR LLE



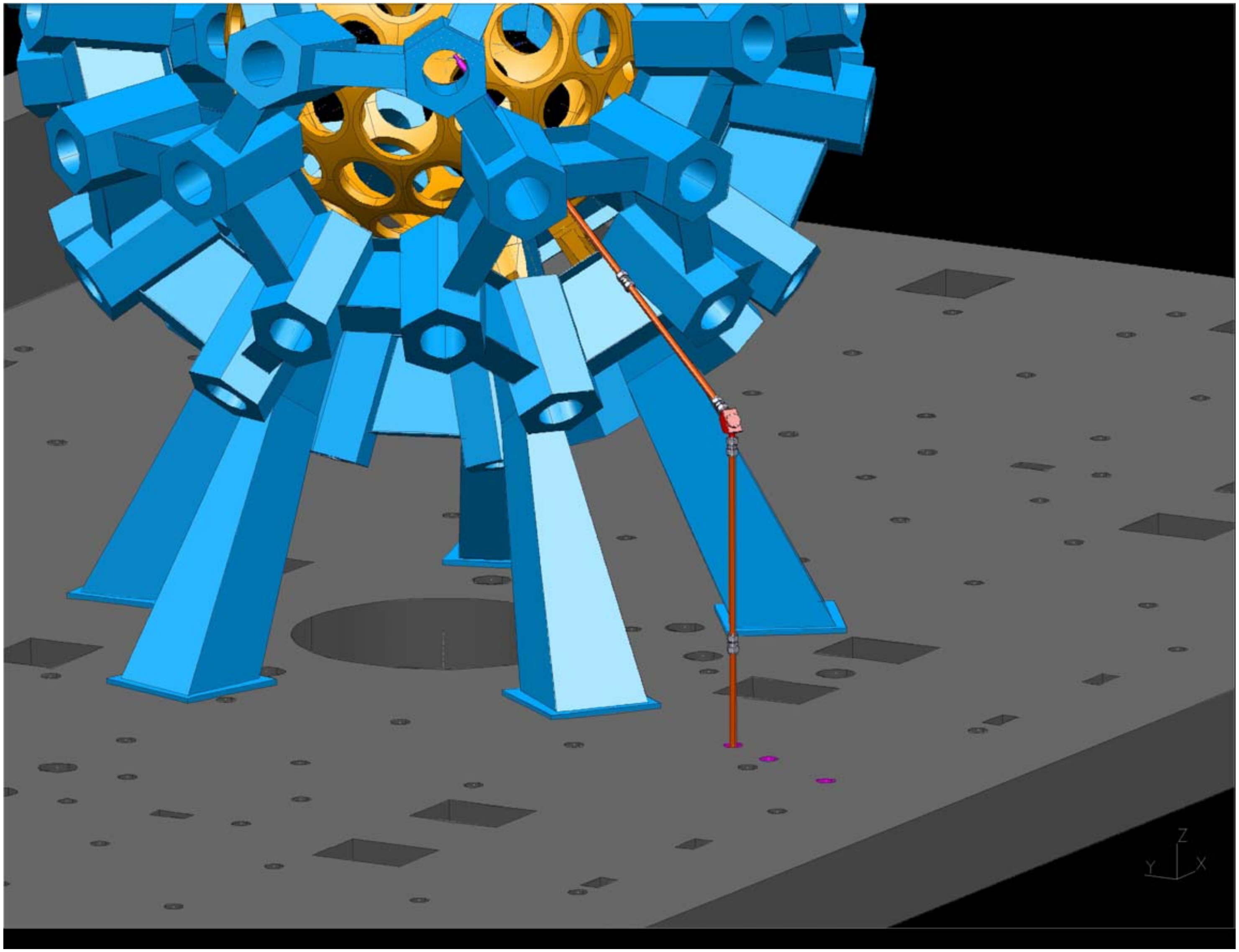
A new reentrant tube for HYNTD will consists from ~2" stainless steel and ~1.25" aluminum parts.

UR LLE



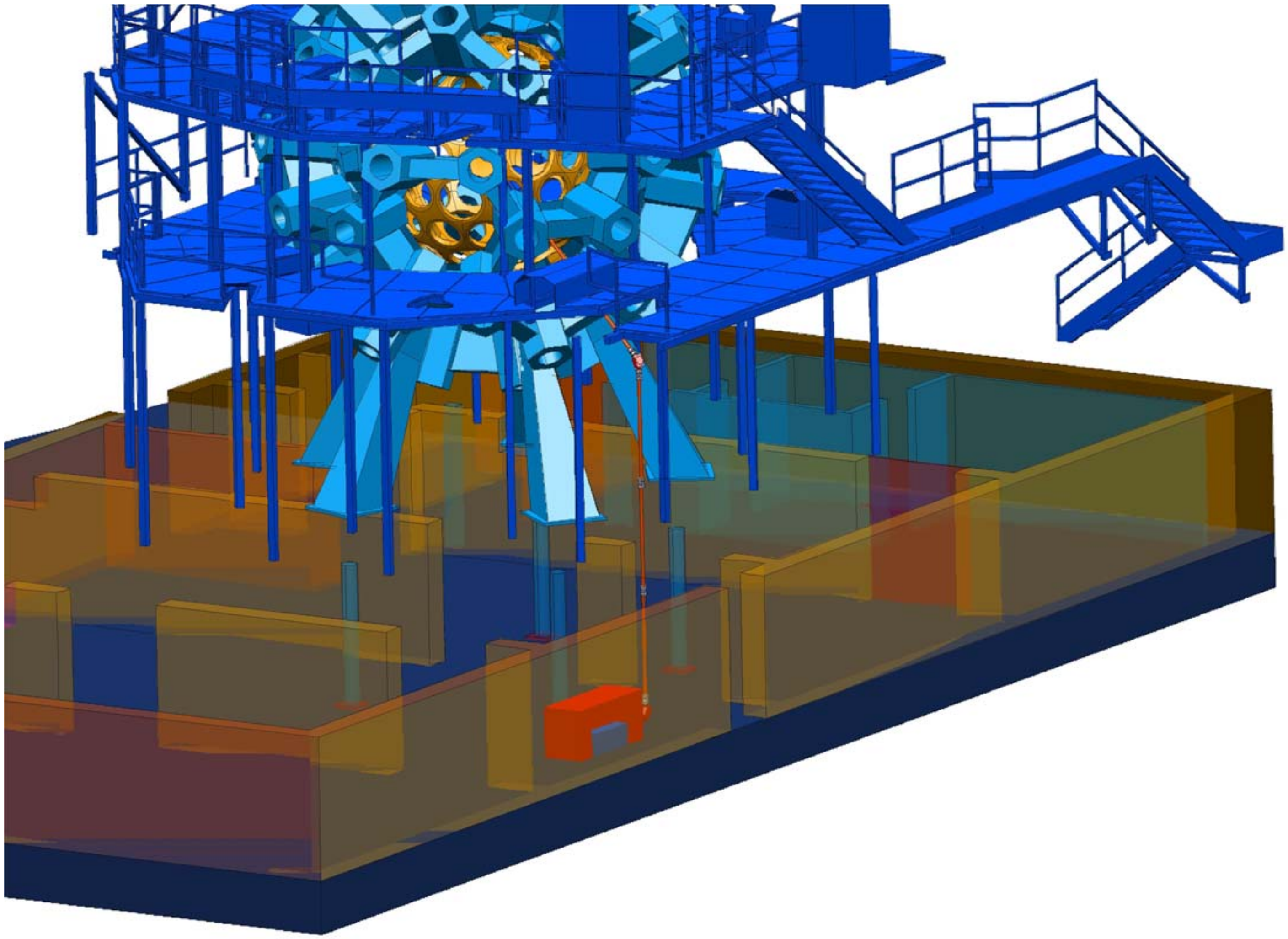
HYNTD in P11A will require to drill a new hole in the floor of the Target Bay.

UR LLE



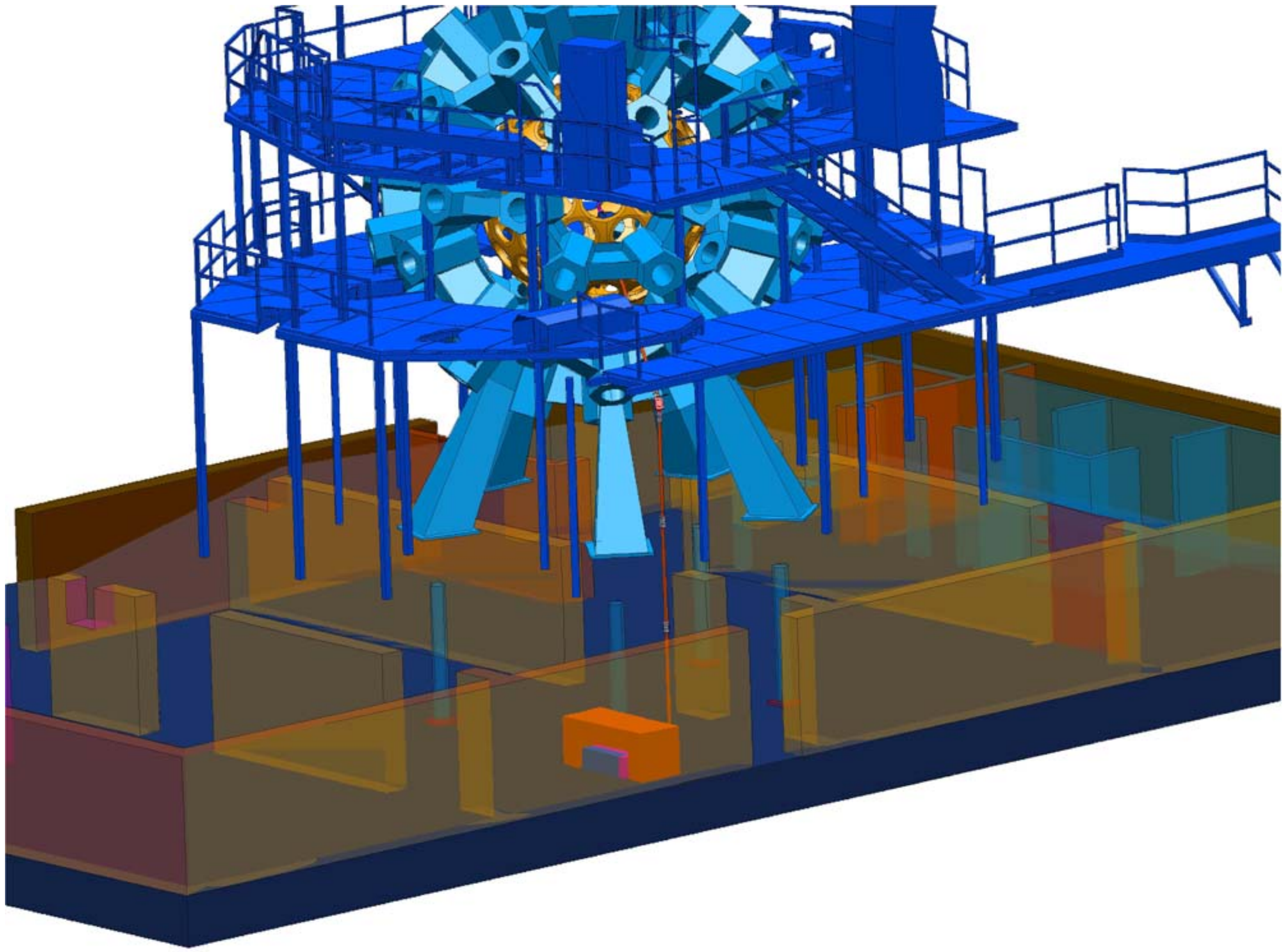
HYNTD will require space for ROSS and neutron shielding in La Cave. ROSS without calibration module.

UR LLE



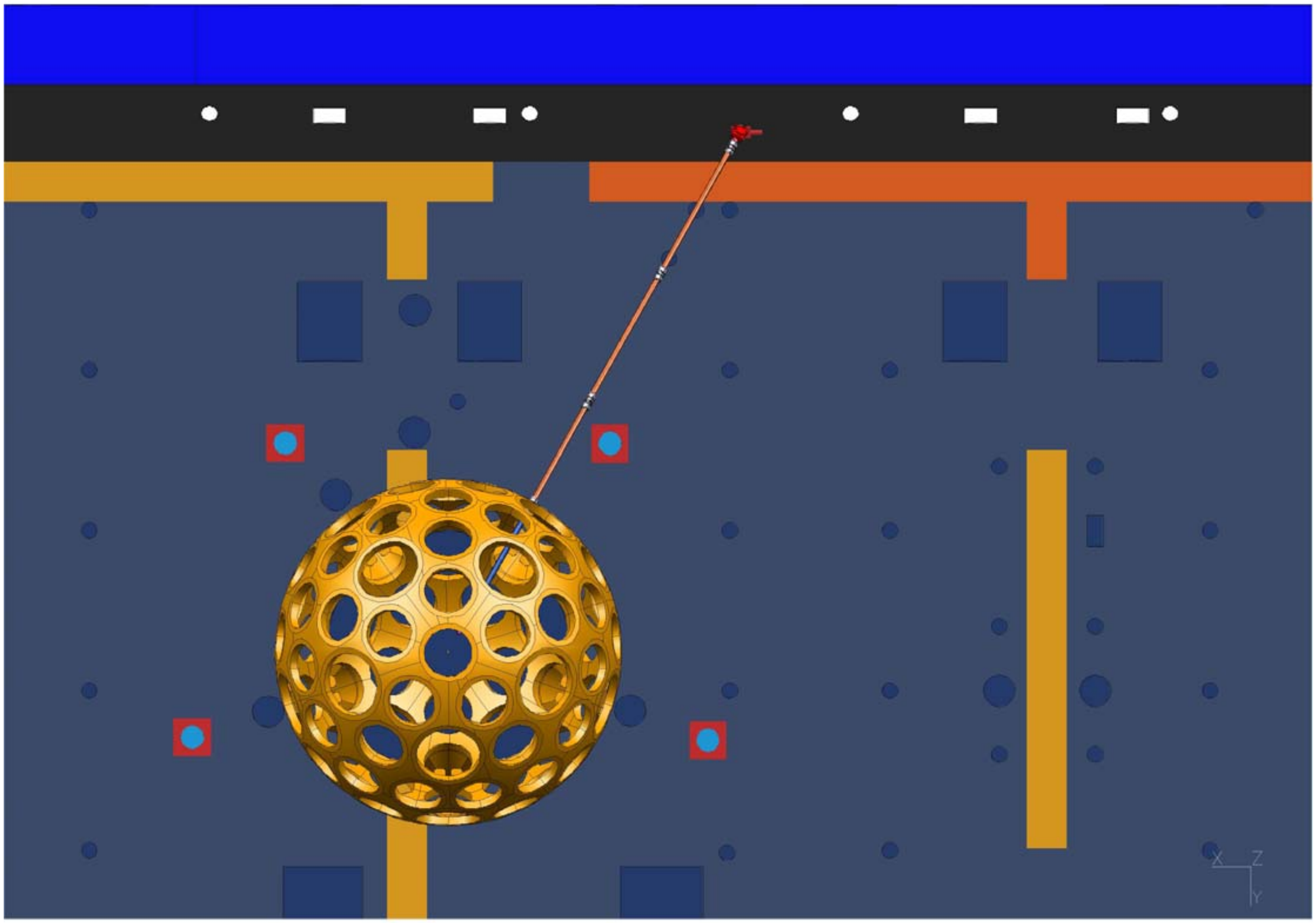
HYNTD will require space for ROSS and neutron shielding in La Cave. ROSS with calibration module.

UR LLE



In case of very high background during fast ignition shots ROSS can be moved outside of La Cave.

UR LLE



HYNTD manufacturing and installation schedule is determined by KO schedule

UR LLE

• **HYNTD Preliminary design review FDR for hole, tube, and platform**	**11-12/05**
• **Drill hole in the Target Bay and platform modification**	**12/05 – 01/06 m. weeks**
• **Reentrant tube manufacturing**	**12/05**
• **Pipes, support manufactures**	**12/05 – 01/06**
• **HYNTD Final design review**	**02/06**
• **Reentrant tube and KO installation**	**03/06 m. week**
• **HYNTD installation**	**04/06**
• **HYNTD operation**	**05/06**

THE UNIVERSITY OF ROCHESTER

INTRAMURAL CORRESPONDENCE

Laboratory for Laser Energetics

DESIGN REVIEW MEMORANDUM **17 Oct 2005**

TO: All Attendees

COPIES: D. Meyerhofer, S. Loucks

FROM: V. Glebov

SUBJECT: **High Yield Neutron Temporal Diagnostic CDR – Oct 14, 2005**

Reference: Design review materials at: \\Hopi\Experimental\DiagnosticDevelopment\HYNTD

Attendees:

W. Armstrong	V. Glebov	J. Reid
A Dillenbeck	G Pien	T Sangster
C Fullone	S Roberts	C Stoeckl
T Duffy	K Thorp	T Wilson
R Keck	M Meleski	C Culligan
		J Soures

Vladimir Glebov presented the CDR for the High Yield Neutron Temporal Diagnostic for Omega. The existing OMEGA Neutron Temporal Diagnostic (NTD) streak camera located in the Target Bay is saturated by neutron-induced background at neutron yields higher than $3 \times 10^{13} – 5 \times 10^{13}$. Experiments with cryogenic DT target may exceed this yield limit. Fast Ignition experiments using both OMEGA and OMEGA-EP lasers can produce neutron yield up to 1×10^{15}. Therefore a new High Yield Neutron Temporal Diagnostic (HYNTD) is required for the future experiments on OMEGA. Recent tests on OMEGA demonstrated feasibility of a new NTD detector based on a light pipe. In this approach light from a scintillator in reentrant tube delivered to streak camera outside of the Target Bay area by a polished stainless pipe. The goal of this project is to build HYNTD based on a light pipe.

Vladimir Glebov presented result of light pipe tests that effected a HYNTD design. The project encompasses the deployment of a 2"/1.25" reentrant tube to a P11A sub-port and a 2" light pipe to a ROSS streak camera located in LaCave. Mechanical Group analysed all other sub-ports as possible HYNTD location and rejected all of them because of beam of equipment interfierence. The location of the HYNTD in the P11A sub-port will allow simultaneous operation of the HYNTD and KO2 in sub-port P11D as it was dicussed in OMEGA KO retractors FDR 09/14/2005. The proposed HYNTD design, manufacturing, and installation schedule maximize the use of KO2 for cryogenic experiments.

The following summarizes the discussions:

Discussion
A hole must be drilled in the floor of the target bay. This hole size and position must be finalized by the PDR.

The nose tip must be made out of aluminum; the steel tip attenuation is too high.

The P11 platform must be modified to accommodate HYNTD in P11A sub-port. The platfort modification must be finalized by the PDR.

The ROSS streak camera will be installed on the floor of LaCave. The floor is the best location for shielding and distance.

The light pipe turning mirrors and junctions will require rigid support. This needs to be designed for the FDR.

Controls and software requirements need to be defined by the PDR.

Action Items:

#	**Items**	**Responsibility**
1	Target Bay Hole Location	V. Glebov, ME, G. Pien
2	P11 platform modification	S. Roberts, ME, G. Pien
3	HYNTD design	V. Glebov, S. Roberts, ME
4	Controls and Software Requirements	V. Glebov and System Eng
5	Optical fiducial for HYNTD	V. Glebov